Switching between external and internal attention in hippocampal networks

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Introduction

We constantly switch between paying attention to the outside world and our own thoughts/memories.

The hippocampus is involved in both **external** and **internal** attention.[1,2,3]

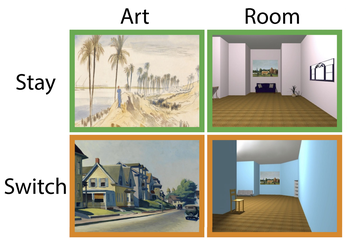
The basal forebrain biases the hippocampus toward external processing. [4]

The dorsal attention network (DAN) provides attentional resources to facilitate memory retrieval.[5]

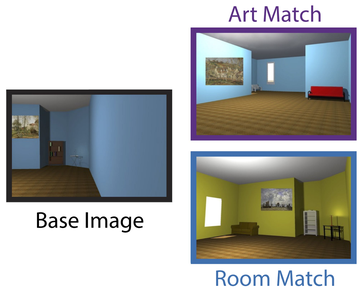
Hypothesis: Hippocampal connectivity[6,7] differentiates between external and internal attentional states.

Task Design

Cue Learning

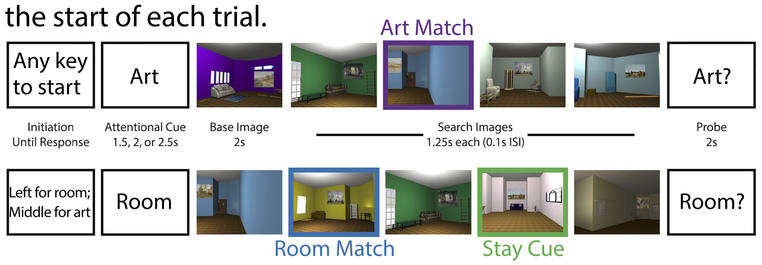


Sample Task Stimuli



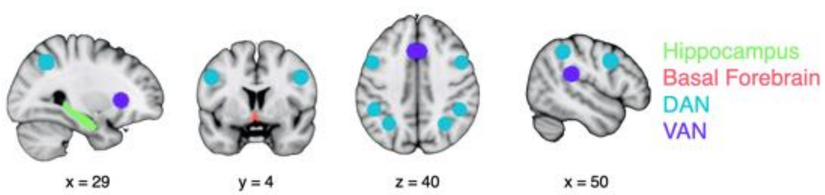
External vs. Internal Attention Task

Explicitly-Instructed Condition: Attentional state is assigned at the start of each trial.



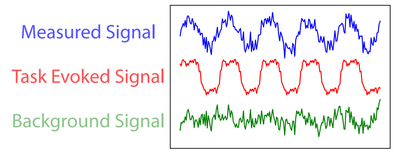
Memory-Guided Condition: Attentional state is chosen based on the stay/switch cue from the previous trial

Regions of Interest

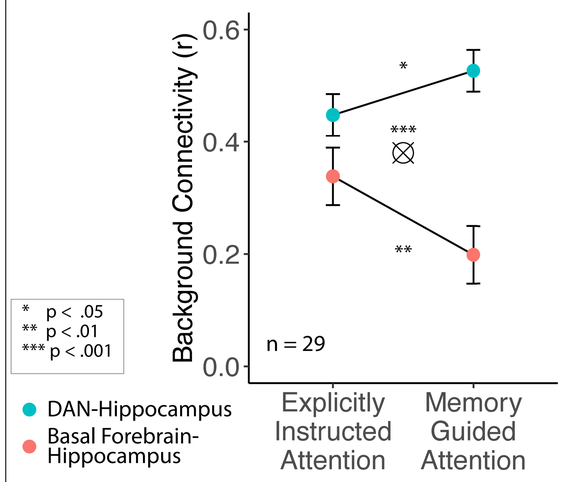


Background Connectivity

Remove task-evoked response[6]:

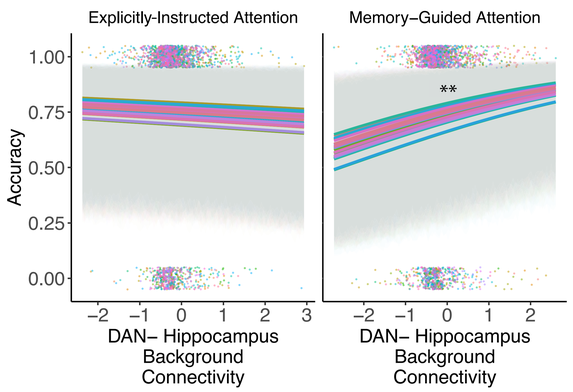


Hippocampus connectivity



Hippocampus connectivity patterns flip with varying external vs. internal attention demands

Background Connectivity and Task Performance

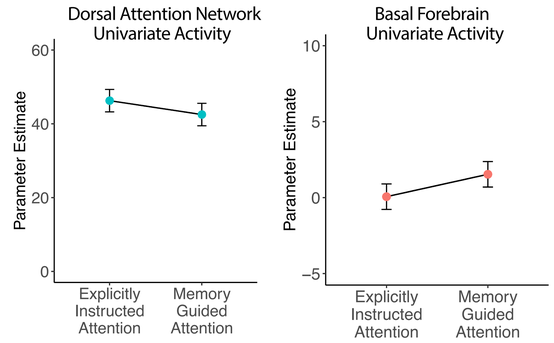


DAN-Hippocampus connectivity predicts accuracy on the memory-guided condition

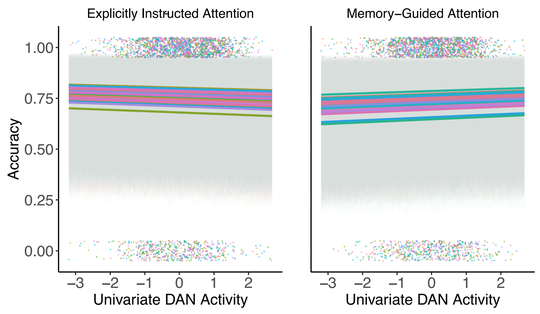
Basal Forebrain-Hippocampus connectivity not related to attention task performance

Control Analyses

1 Selective to connectivity?

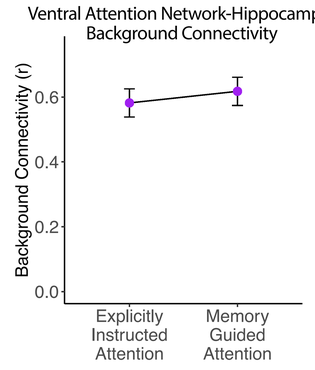


Univariate activity does not differ across explicitly-instructed and memory-guided tasks



Univariate DAN activity does not predict accuracy on explicitly-instructed or memory-guided tasks

2 Selective to these networks?



Ventral attention network background connectivity with hippocampus does not differ across task conditions

Conclusions

- Hippocampus shows differential connectivity patterns during externally cued vs. internally guided attention.
- Basal Forebrain shows higher connectivity with hippocampus when external attention demands are proportionately higher.
- DAN shows higher connectivity with hippocampus when internal attention demands are proportionately higher.
- DAN interactions with hippocampus are related to better performance on a memory-guided attention task.

1. Aly & Turk-Browne (2016). *Cerebral Cortex* 2. Honey et al. (2012). *Net Neuro* 3. Günseli & Aly (2020). *eLife*
4. Tarder-Stoll, Jayakumar, et al. (2020). *Neuropsychologia* 5. Cabeza. (2008). *Neuropsychologia*
6. Al-Aidroos et al. (2012). *PNAS* 7. Li et al. (2022). preprint

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